CHAPTER 17

ROLLER-COMPACTED CONCRETE PAVEMENTS

17-1. Introduction.

Roller-compacted concrete pavement (RCCP) is a zero-slump portland cement concrete mixture that is placed with an asphalt concrete paving machine and compacted with vibratory and rubber-tired rollers. Mixture proportions and most engineering properties of RCCP are similar to those of conventional plain concrete pavements. The mixture proportions of RCCP are not appreciably different than those used in conventional concrete; flexural strengths of beams taken from RCCP facilities and test sections routinely exceed 650 psi at 28 days. Limited tests have shown that the fatigue characteristics of RCCP mixtures are similar to those of conventional concrete pavement mixtures. In Canada under moderately severe environmental and heavy loading conditions, RCCP hardstands have performed well for over 10 years alongside conventional concrete hardstands. Therefore, it may he assumed that the same rationale applied to the thickness design for plain nonreinforced concrete pavement thickness may also be applied to the design of RCCP.

17-2. Load Transfer.

A major difference exists in the assumptions of load transfer at joints made for plain concrete pavements and RCCP, which directly effects the design stress and therefore the thickness of the pavement. RCCP has typically been allowed to crack naturally, and spacings between these cracks are usually irregular, ranging from 40 to 70 feet apart (although spacings much greater and much lower than these have been reported). Consequently, the width of the crack opening will he greater and the load transfer developed from aggregate interlock at the cracks will be highly variable, if not totally lost. Limited tests at Fort Hood, TX, and Fort Steward, GA, have revealed average load transfer at transverse contraction cracks of 18.6 percent (standard deviation of 6.7 percent) and longitudinal cracks 16.7 percent (standard deviation of 5.9 percent), respectively. Tests on longitudinal and transverse cold (construction) joints revealed even less load transfer. Therefore, the assumption of 25 percent load transfer at joints in open storage areas constructed of plain concrete would not be valid for RCCP thickness design. The approach then would be to base the thickness design of RCCP on no load transfer at the joints, i.e. assuming all joints/cracks to be a free edge condition.

17-3. Thickness Design.

The thickness design curves shown in figure 12-1 will be used to determine thickness requirements for RCCP. These curves are the same as used for plain concrete roads and streets.

17-4. Multilift Pavements.

The maximum lift thickness that can be placed at an acceptable grade and smoothness and compacted to a uniform density is about 10 inches. Therefore, if the RCCP design thickness is greater than 10 inches, two or more lifts will be necessary to achieve the design thickness. If possible, the upper lift should be of minimal thickness, preferably one-third of the total pavement thickness (but no less than 4 inches), to aid in creating a smoother surface finish. The type of bond achieved between the lifts is a function of the construction sequence and timing and will govern the method of thickness design used for multilift RCCP. The three types of bonding conditions to be considered in RCCP thickness design are full bond, partial bond, and no bond.

a. Full bond. Full bond may be assumed between adjacent lifts if they are placed and compacted within 1 hour of each other, or if a thin grout is placed between the upper and lower lifts. The surface of the lower lift must be kept clean and moist until the upper lift is placed and should not he rolled with the rubber-tired roller. If the full bond condition is achieved, the thickness should be determined as if a monolithic slab were used, with no consideration for the joint between lifts in the thickness design calculations.

b. Partial bond. Partial bond should be assumed between subsequent lifts if they are placed and compacted more than 1 hour apart. The surface of the lower lift must he kept clean and moist until the upper lift is placed. The thickness should be designed as a rigid overlay of a rigid base pavement with partial bonding according to the guidance in chapter 14.

c. No bond. No bond may be assumed between adjacent lifts if some type of bond breaker is used between the lifts, such as a curing compound or asphalt emulsion sprayed on the surface of the lower lift. The thickness should be designed as a

rigid overlay of a rigid base pavement with no bond, according to the guidance in chapter 14.

17-5. Joint Types for RCC.

a. Expansion joints. Expansion joints, within an area paved with RCC, will not be required except to protect facilities located within the paved area.

b. Contraction joints. Generally, longitudinal contraction joints will not he required in RCC pavements. However, most RCC pavement to date has been allowed to crack naturally in the transverse direction. These cracks usually occur randomly at 40- to 70-foot spacings, and have performed well, with little raveling or faulting. The natural cracks are typically not sealed; however, it is recommended that all cracks be routed and sealed in areas where the pavement may be susceptible to frost damage. Sawing of contraction joints is recommended at spacings of 50 to 75 feet, providing the sawing can be accomplished in the first 24 hours without excessive raveling. The optimum time for sawing and optimum transverse joint spacing should be determined during the test section construction. Depth of sawcut should be one-third of the pavement thickness. For multilift pavements, the sawcut should be made one-third the pavement depth if full bond conditions are used. If partial bond or no bond conditions are used, the sawcuts should be made in each lift in coinciding locations to one-third the lift thickness (the sawcuts in the lower lifts may be made 1 hour after compaction). The longitudinal and transverse cold joints for each lift should always coincide. All sawed joints should he sealed.

c. Construction joints. Currently, there are two types of construction joints in RCC paving-fresh and cold. When fresh concrete can he placed and compacted against in-place concrete prior to initial set (usually within 90 minutes), the juncture or joint will he considered to he a fresh joint and no special treatment will be required. For the construction of a fresh joint, the edge of the in-place concrete is left uncompacted and rolled after the adjoining concrete has been placed. When the in-place RCC has stiffened significantly before the adjoining fresh concrete can he placed (usually around 90 minutes), the resulting juncture will be considered a cold construction joint. The in-place concrete must be fully compacted and then the edge trimmed back to solid concrete to form a near vertical face. If the required density or smoothness is not obtained, then the in-place concrete must be removed. Immediately prior to placement of the adjoining concrete, the vertical edge should be dampened. After placement of the fresh concrete, the excess which spills onto the compacted material should he pushed back to the edge of the fresh concrete before rolling. No effort will be made to achieve load transfer at the cold joint. Every effort should be made to keep cold longitudinal construction joints spaced at least 50 to 75 feet.